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(54) Title: SYSTEM AND METHOD FOR LOCATION-SENSITIVE HANDLING OF TELEPHONE CALLS TO MOBILE STATIONS

(57) Abstract: A system and method are disclosed for handling incoming telephone calls intended for a mobile telephone located within a predefined area, such as a building or compound. The system includes a plurality of base stations, each base station corresponding to a distinct sub-area within the predefined area and capable of communicating with the mobile telephone when the mobile telephone is located within the respective sub-area. The system further includes a switching device for controlling communication with the mobile telephone. In addition, the switching device identifies the current sub-area in which mobile telephone is located, maintains a database indicating whether each sub-area is designated as a quiet area whereby incoming telephone calls to the mobile telephone are prohibited while the mobile telephone is located within the quiet area, and directs the incoming telephone call elsewhere upon an affirmative determination that the current sub-area is designated as a quiet area.

SYSTEM AND METHOD FOR LOCATION-SENSITIVE HANDLING OF
TELEPHONE CALLS TO MOBILE STATIONS

BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention relates to a system and method for handling incoming telephone calls to a mobile telephone, and particularly to a system and method for selectively directing an incoming telephone call from a mobile telephone destination based upon a particular location of the mobile telephone within a building or compound.

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Background of the Invention

In an effort to facilitate communication, a number of companies have encouraged its employees to utilize mobile telephones during times when an employee is not in his office. In some instances, companies even provide mobile telephones to its employees in order to ensure that the provided employee may be easily contacted.

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Telephone call distribution systems are presently used by companies for receiving incoming telephone calls and forwarding the telephone calls to the appropriate individual, such as to an individual's mobile telephone. Communications systems even exist in which incoming calls to an employee's wireline desk telephone are automatically forwarded to the employee's mobile telephone in the event the wireline desk telephone is unanswered. There are circumstances, however, in which an employee's mobile telephone should not receive an incoming call. For instance, if an

individual is in an important business meeting or if a medical provider is in surgery, it may not be best to forward a telephone call thereto. In such circumstances, the location of an individual is best known before a telephone call is forwarded thereto. Companies thus have an interest in determining the location of an individual, such as an employee, and selectively forwarding a telephone call to a mobile telephone used thereby based upon the determined location thereof.

Based upon the foregoing, there exists a need to better track the positioning of a mobile telephone and thus its users within a building, compound or other predefined area, and automatically directing or deflecting incoming telephone calls elsewhere when the mobile telephone is in an area in which the mobile telephone should not receive a telephone call.

SUMMARY OF THE INVENTION

The present invention overcomes shortcomings in existing telephone call handling systems and satisfies a significant need for a system and method for deflecting incoming telephone calls to a mobile telephone based upon the position thereof within a predefined area, such as a building or compound. The present invention is adapted for use by companies as part of or in conjunction with conventional communications systems maintained thereby.

According to a preferred embodiment of the present invention, the building or other predefined area is partitioned into a plurality of zones, with each zone including one or more cells defined therein. Each cell is associated with a base station such that a mobile

telephone located within the cell communicates with the corresponding base station over the air interface. Each base station communicates with a telecommunications switch via a radio exchange. In this way, a mobile 5 telephone located within any one of the cells is capable of participating in a speech communication.

According to the preferred embodiment of the present invention, each active mobile telephone which is not engaged in a speech communication periodically 10 transmits a distinct identification signal. The identification signal is received by the base station corresponding to the cell in which the transmitting mobile telephone is located. The identification signal received by the base station is forwarded to the 15 switch, whereupon the identification information is compared with a list of identification data to determine the owner of the mobile telephone. In addition, the switch is capable of determining the particular zone or cell from which the mobile telephone 20 transmitted the identification signal.

Specifically, each time the switch determines that a mobile telephone has entered a cell, the entered cell is logged in a database as the current cell. When the switch then determines, based upon subsequent 25 transmissions of the identification signal by the mobile telephone, that the mobile telephone has exited the cell and has entered a new cell, data is stored into the database to document the new cell as the current cell. In the event a mobile telephone no 30 longer periodically transmits its identification signal, data the database to document the mobile telephone ceasing transmission in the cell. In this way, data is stored in the database for sufficiently

documenting the position of the active mobile telephone within the building or other predefined area.

The switch further includes the capability of designating cells as "quiet areas" whereby incoming telephone calls to a mobile telephone located in the quiet area should not be directed to the intended mobile telephone and instead directed to a system operator or the corresponding subscriber's voicemail. Cells designated as quiet areas include rooms in which activities are best performed in an uninterrupted manner, such as conference rooms and auditoriums. In the preferred embodiment of the present invention, cells may be classified as a quiet area or a noisy area in which incoming telephone calls are allowed. The cell area classifications are stored in a second database by a system manager.

In the event an incoming telephone call intended for a mobile telephone is received by the switch of the telecommunications system, the switch retrieves the cell location data for the mobile telephone from the first database and then retrieves the cell classification information from the second database for the particular cell location retrieved from the first database. Upon an affirmative determination that the retrieved cell classification data retrieved from the second database establishes that the mobile telephone is located in an area designated a quiet area, the switch deflects the incoming telephone call to either a system operator or the voicemail of the subscriber of the mobile telephone, based upon a preference previously specified by the subscriber. In addition to deflecting the incoming telephone call to the subscriber's preferred destination, for incoming

5 emergency telephone calls the switch may send an indication to the mobile telephone that an incoming telephone call was deflected. The indication may silently inform the user of the mobile telephone that an incoming telephone call intended therefor was directed elsewhere. In all, the present system is capable of diverting incoming telephone call and informing the corresponding subscriber without interrupting the subscriber and those in the vicinity 10 thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

15 A more complete understanding of the system and method of the present invention may be obtained by reference to the following Detailed Description when taken in conjunction with the accompanying Drawings 20 wherein:

Figure 1 is a block diagram of the present mobile communications system according to a preferred embodiment of the present invention;

Figure 2 is a first flow chart illustrating a first set of operations of the mobile communications system according to the embodiment of Figure 1; and

25 Figure 3 is a second flow chart illustrating a second set of operations of the mobile communications system according to the embodiment of Figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EXEMPLARY EMBODIMENTS

30 The present invention will now be described more fully hereinafter with reference to the accompanying drawings in which a preferred embodiment of the invention is shown. This invention may, however, be

embodied in many different forms and should not be construed as being limited to the embodiment set forth herein. Rather, the embodiment is provided so that this disclosure will be thorough and complete, and will 5 fully convey the scope of the invention to those skilled in the art.

Referring to Figure 1, there is shown a mobile 10 communications system 1 according to a preferred embodiment of the present invention. Mobile communications system 1 preferably provides conventional voice and other communication to one or more mobile telephones 2 which are situated within the predefined area 3 served thereby. Predefined area 3 may preferably be the area within a building, compound 15 or other relatively small geographical area.

In addition, mobile communications system 1 is capable of determining the position of one or more active mobile telephones 2 in predefined area 3 served thereby. The predefined area 3 is divided into a 20 number of zones 4, with each zone 4 being further divided into one or more cells 5. For each cell 5 within predefined area 3, mobile communications system 1 includes a base station 6 corresponding thereto. Each base station 6 is associated with at least one 25 distinct cell 5 such that mobile communications system 1 provides mobile telephone service to a mobile telephone 2 via the particular base station 6 corresponding to the cell 5 in which the mobile telephone 2 is located.

30 In providing conventional mobile telephone service, mobile communications system 1 further includes a switch 7 which controls telephone calls between one or more mobile telephones 2 and terminals

in other telephone and/or data systems. Mobile communications system 1 may further include a radio exchange 8 which communicates with each base station 6, and a mobility server 9 which communicates directly 5 with radio exchange 8 and switch 7 as is known in the art.

In a preferred embodiment of the present invention, each mobile telephone 2 preferably includes necessary software, hardware and/or firmware for transmitting an identification signal. The identification signal for each mobile telephone 2 preferably includes a unique code that is transmitted over a data channel. Mobile telephone 2 periodically transmits the identification signal. For example, 10 mobile telephone 2 may transmit its identification signal every five seconds. It is understood, however, that the frequency with which mobile telephone 2 transmits the identification signal may vary and depend upon a variety of factors, such as channel bandwidth. 15 Mobile telephone 2 preferably periodically transmits its identification signal whenever mobile telephone 2 is active and not involved in a speech communication. 20

Each base station 6 is preferably capable of receiving the identification signal from mobile telephone 2 and forwarding the received identification signal to switch 7. Switch 7 is capable of determining the current cell 5 in which the mobile telephone 2 is located, based upon the identification signal forwarded to switch 7. Switch 7 also preferably includes or is 25 associated with a memory device 10 for storing data relating to the current cell 5 of mobile telephone 2 within predefined area 3. The data stored in memory device 10 may include an identification of mobile 30

telephone 2 together with an identification of the current cell 5 in which mobile telephone 2 is located. The stored data forms a first database 11 maintained in memory device 10. With mobile telephone 2 transmitting its identification signal on a periodic basis, database 11 is suitably updated when mobile telephone 2 is active.

In an effort to prevent incoming telephone calls from being directed to a mobile telephone 2 when mobile telephone 2 is located within certain "quiet" areas, such as conference rooms within an office building, switch 7 of mobile communications system 1 preferably maintains a database 12 within memory device 10 which indicates those cells 5 that are designated as quiet areas. Database 12 preferably has an entry for each cell 5 within predefined area 3. Database 12 is preferably accessed by switch 7 when determining whether it is appropriate to block incoming telephone calls to mobile telephone 2, as described below.

The designation data in database 12, which indicates whether a cell 5 has been designated a quiet area, is programmable by a system operator using a computer 13 in communication with switch 7.

The operation of a preferred embodiment of the present invention will be described with reference to Figures 2 and 3. In the event mobile telephone 2 is active and not involved in a speech connection, base station 6 receives an identification signal transmitted by a mobile telephone 2 at step 20 (Figure 2). The base station 6 then forwards the identification signal to switch 7 at step 21. Next, at step 22 switch 7 identifies the particular mobile telephone 2 which transmitted the identification signal and determines

the current cell 5 from which the identification signal was transmitted. The determination of the current cell 5 may be based upon determining which base station 6 forwarded the identification signal to switch 7 during step 21. Next, switch 7 stores in database 11 data relating to the current cell 5 of mobile telephone 2 at step 23. At this point, the current cell information in database 11 corresponding to mobile telephone 2 has been updated.

10 The user of mobile telephone 2 may store the desired alternate location for directing incoming telephone calls intended for mobile telephone 2 when mobile telephone 2 is located in a quiet area. In this case, the base station 6 in communication with mobile telephone 2 receives a message therefrom indicating the desired location of incoming telephone calls at step 24, and forwards the message to switch 7 at step 25. Upon receipt of the forwarded message, switch 7 stores the desired location in database 11 at step 26.

20 Once an incoming telephone call intended for a mobile telephone 2 is received by switch 7 at step 30, switch 7 determines at step 31 the mobile telephone 2 to which the telephone call is intended. Having determined the intended mobile telephone 2, switch 7 25 retrieves from database 11 at step 32 the current cell information for mobile telephone 2. At this point, switch 7 has identified the current cell 5 in which mobile telephone 2 is located. Next, switch 7 retrieves designation data from database 12 30 corresponding to the current cell 5 at step 33. The designation data indicates whether the current cell 5 in which mobile telephone 2 is located is designated as a quiet area.

In the event the designation data for current cell 5 indicates that current cell 5 is designated as a quiet area, then switch 7 retrieves from database 11 the preferred alternate location corresponding to 5 mobile telephone 2 at step 34 and thereupon directs the incoming telephone call to the preferred location step 35. In addition, if the incoming telephone call is determined to pertain to an emergency, switch 7 sends a message to mobile telephone 2 at step 36 which informs the user thereof that an incoming telephone 10 call intended for mobile telephone 2 was directed to the preferred location. The message may be visually presented by mobile telephone 2 by appearing as text on the visual display thereof. Alternatively, mobile 15 telephone 2 may vibrate upon receiving the message. In this way, incoming telephone calls intended for a mobile telephone 2 are diverted elsewhere while mobile telephone 2 is located in a previously designated quiet area. Further, the user of mobile telephone 2 is only 20 interrupted when an emergency telephone call is routed elsewhere.

In the event the designation data for current cell 5 indicates that current cell 5 is not designated as a quiet area, switch 7 determines that there are no 25 geographical-based restrictions in communicating with mobile telephone 2 and thereupon directs the incoming telephone call to mobile telephone 2 at step 37.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such 30 variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the

following claims.

WHAT IS CLAIMED IS:

1. A method for handling an incoming telephone call intended for a mobile telephone located within a predefined area, comprising the steps of:

receiving the incoming telephone call;

5 identifying a sub-area within the predefined area in which the mobile telephone is located;

determining whether the identified sub-area is designated as a quiet sub-area in which incoming telephone calls to the mobile telephone are prohibited;

10 and

directing the incoming telephone call intended for the mobile telephone elsewhere based upon an affirmative determination that the identified sub-area is designated as a quiet sub-area.

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2. The method of claim 1, wherein said step of determining comprises the step of:

20 retrieving designation data from memory relating to the sub-area in which the mobile telephone is located that indicates whether the identified sub-area is designated as a quiet area.

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3. The method of claim 1, wherein said step of identifying comprises the steps of:

receiving a signal from the mobile telephone;

determining a sub-area from which the mobile telephone transmitted the signal; and

30 storing data in memory relating to the sub-area from which the mobile telephone transmitted the signal.

4. The method of claim 3, wherein said step of identifying further comprises the step of:

repeating said steps of receiving a signal, determining a sub-area and storing data substantially periodically.

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5. The method of claim 3, wherein:

10 said step of receiving a signal comprises periodically receiving a signal from the mobile telephone;

said step of determining a sub-area comprises determining a sub-area from which the mobile telephone transmitted each received signal; and

15 said step of storing comprises storing data in memory relating to the sub-area from which the mobile telephone transmitted each signal periodically received during said step of receiving.

20 6. The method of claim 1, further comprising the step of:

prior to said step of determining, designating at least one sub-area in the predefined area as a quiet area.

25 7. The method of claim 1, further comprising the step of:

30 prior to said step of determining, designating at least one sub-area in the predefined area as an area in which incoming telephone calls to the mobile telephone are allowed.

8. The method of claim 1, further comprising the step of:

selecting a location for directing incoming telephone calls intended for the mobile telephone, the incoming telephone call being directed to the selected location during said step of directing.

5 9. The method of claim 1, wherein said step of directing comprises the step of:

10 directing the incoming telephone call to an operator based upon an affirmative determination that the identified sub-area is designated as a quiet sub-area.

15 10. The method of claim 1, wherein said step of directing comprises the step of:

20 directing the incoming telephone call to a voicemail corresponding to a user of the mobile telephone based upon an affirmative determination that the identified sub-area is designated as a quiet sub-area.

11. The method of claim 1, further comprising the step of:

25 directing the incoming telephone call intended for the mobile telephone to the mobile telephone based upon an affirmative determination that the identified sub-area is not designated as a quiet sub-area.

12. A system for handling an incoming telephone call intended for a mobile telephone located in a predefined area, comprising:

5 a plurality of base stations, each base station corresponding to at least one distinct cell area within the predefined area and capable of communicating with the mobile telephone when the mobile telephone is within the respective cell area; and

10 a switching device, in communication with each of said base stations, for identifying the current cell area in which the mobile telephone is positioned, maintaining a designation of at least one cell area as a quiet area whereby incoming telephone calls to the mobile telephone are prohibited when the mobile 15 telephone is located in the quiet area, and directing the incoming telephone call elsewhere upon an affirmative determination that the current cell area is designated as a quiet area.

20 13. The system of claim 12, wherein:

said switching device includes memory for storing data relating to the current cell in which the mobile telephone is located.

25 14. The system of claim 12, wherein:

said switching device includes memory for storing designation data for each cell area indicating whether the cell area is designated as a quiet area.

15. The system of claim 14, wherein:
said switching device receives the incoming telephone call, determines that the mobile telephone is the intended destination of the incoming telephone call, retrieves data relating to the current cell of the mobile telephone, retrieves said designation data corresponding to the current cell of the mobile telephone, and directs the incoming telephone call based upon said designation data.

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16. The system of claim 14, wherein:
said designation data is programmable by an operator of said system.

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17. The system of claim 12, wherein:
each said base station is capable of periodically receiving an identification signal transmitted by the mobile telephone and sending an indication of said identification signal to said switching device.

20

18. The system of claim 12, wherein:
said switching device includes a memory device, determines the current cell in which the mobile telephone is located and stores data relating to the current cell and the mobile telephone in said memory device.

25

19. The system of claim 12, wherein:
said switching device directs the incoming telephone call to a location previously specified by a user of the mobile telephone.

20. The system of claim 12, wherein:

5 said switching device directs the incoming telephone call to a voicemail of the user of the mobile telephone upon an affirmative determination that the current cell area is designated as a quiet area.

21. The system of claim 12, wherein:

10 said switching device directs the incoming telephone call to an operator of the system upon an affirmative determination that the current cell area is designated as a quiet area.

22. The system of claim 12, wherein:

15 said switching device directs the incoming telephone call to the mobile telephone upon an affirmative determination that the current cell area is not designated as a quiet area.

23. The system of claim 12, wherein:

20 said switching device sends a message to the mobile telephone for visual display thereon upon the incoming telephone call being directed elsewhere.

24. The system of claim 12, wherein:

25 said switching device sends a signal to the mobile telephone to vibrate the mobile telephone upon the incoming telephone call being directed elsewhere.

25. The system of claim 12, wherein:

30 the predefined area comprises the area in a building.

26. A telecommunications system for communication with a mobile telephone located within a predefined area divided into a plurality of sub-areas, comprising:

5 a receiver for receiving an identification signal transmitted by the mobile telephone;

a location device, in communication with said receiver, for determining the sub-area in which the mobile telephone is located based upon the identification signal transmitted thereby; and

10 a switching device, in communication with said positioning device, for selectively blocking routing of telephone calls intended for the mobile telephone based upon the type of sub-area in which the mobile telephone is located.

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27. The system of claim 26, wherein:

20 said switching device routes telephone calls intended for the mobile telephone to a location specified by a user of the mobile telephone based upon by the type of sub-area in which the mobile telephone is located.

28. The system of claim 26, wherein:

25 said switching device routes the telephone calls to an operator of system based upon by the type of sub-area in which the mobile telephone is located.

29. The system of claim 26, wherein:

30 said switching device routes the telephone calls to a voicemail of the user of the mobile telephone.

30. The system of claim 26, further comprising:
a memory device, in communication with said
switching device, for storing designation data
corresponding to each sub-area, said designation data
5 for a sub-area specifying whether the sub-area is a
quiet area whereby incoming telephone calls to the
mobile telephone are prohibited while the mobile
telephone is located in the quiet area.

10 31. The system of claim 30, wherein:
said switching device retrieves said designation
data from said memory device corresponding to the sub-
area in which the mobile telephone is located, and
routes incoming telephone calls intended for the mobile
15 telephone to another location based upon said switching
device determining that the sub-area in which the
mobile telephone is located is designated a quiet area.

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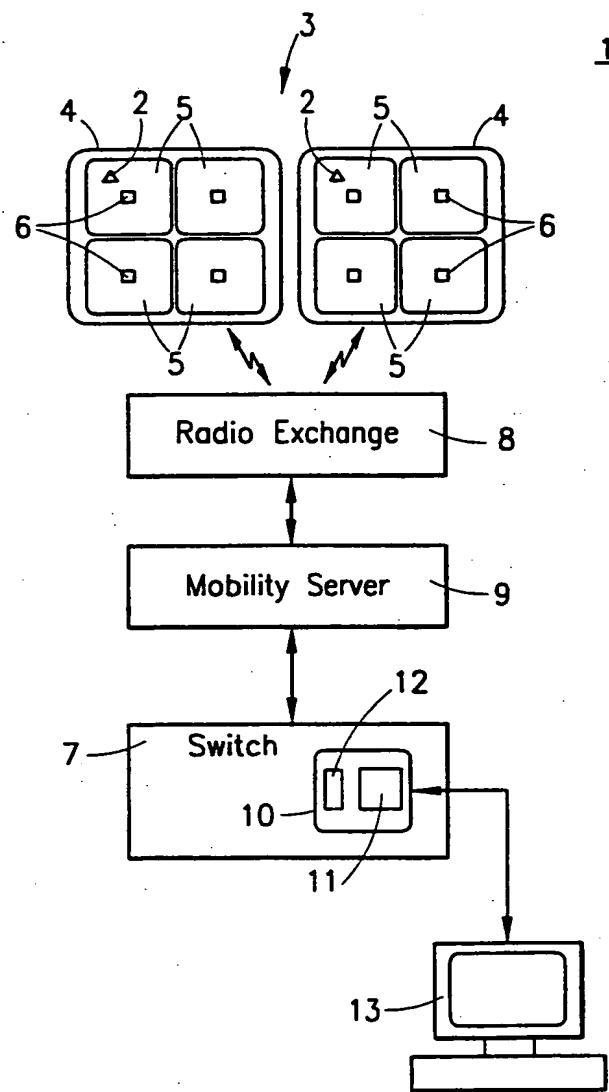


FIG. 1

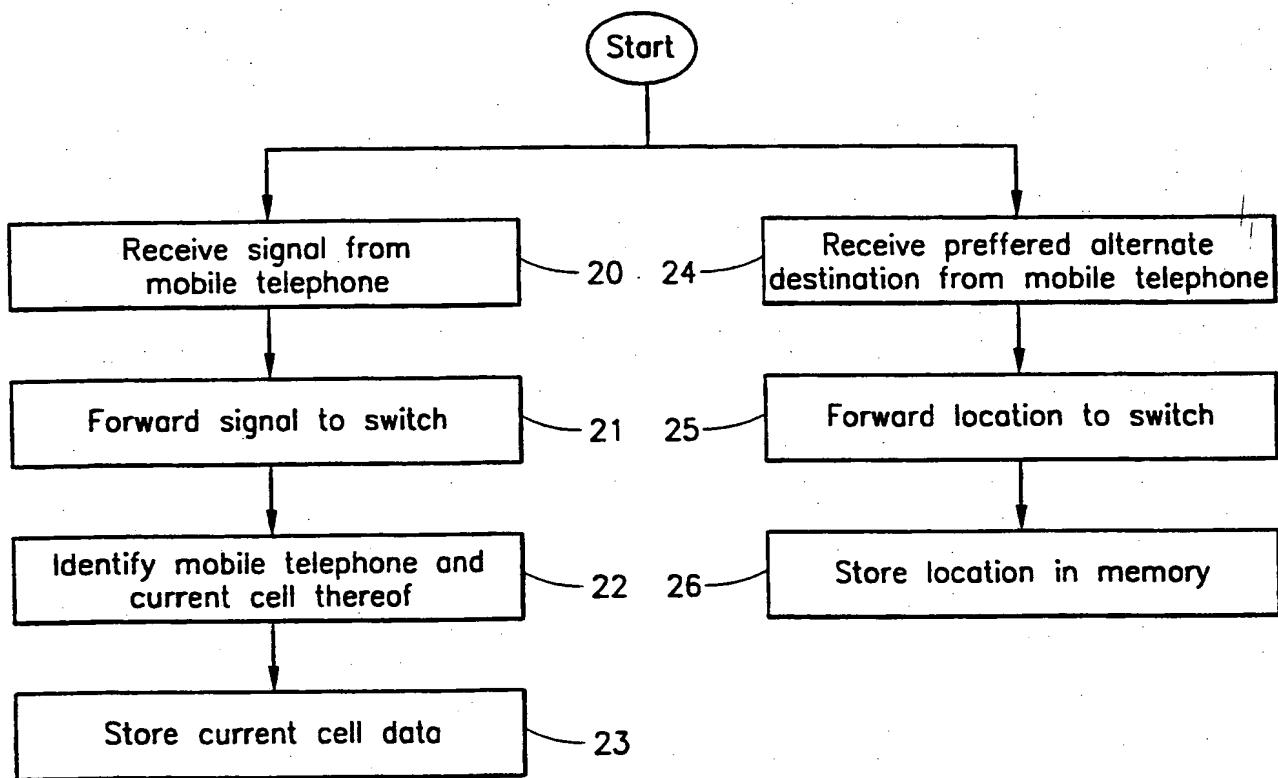


FIG. 2

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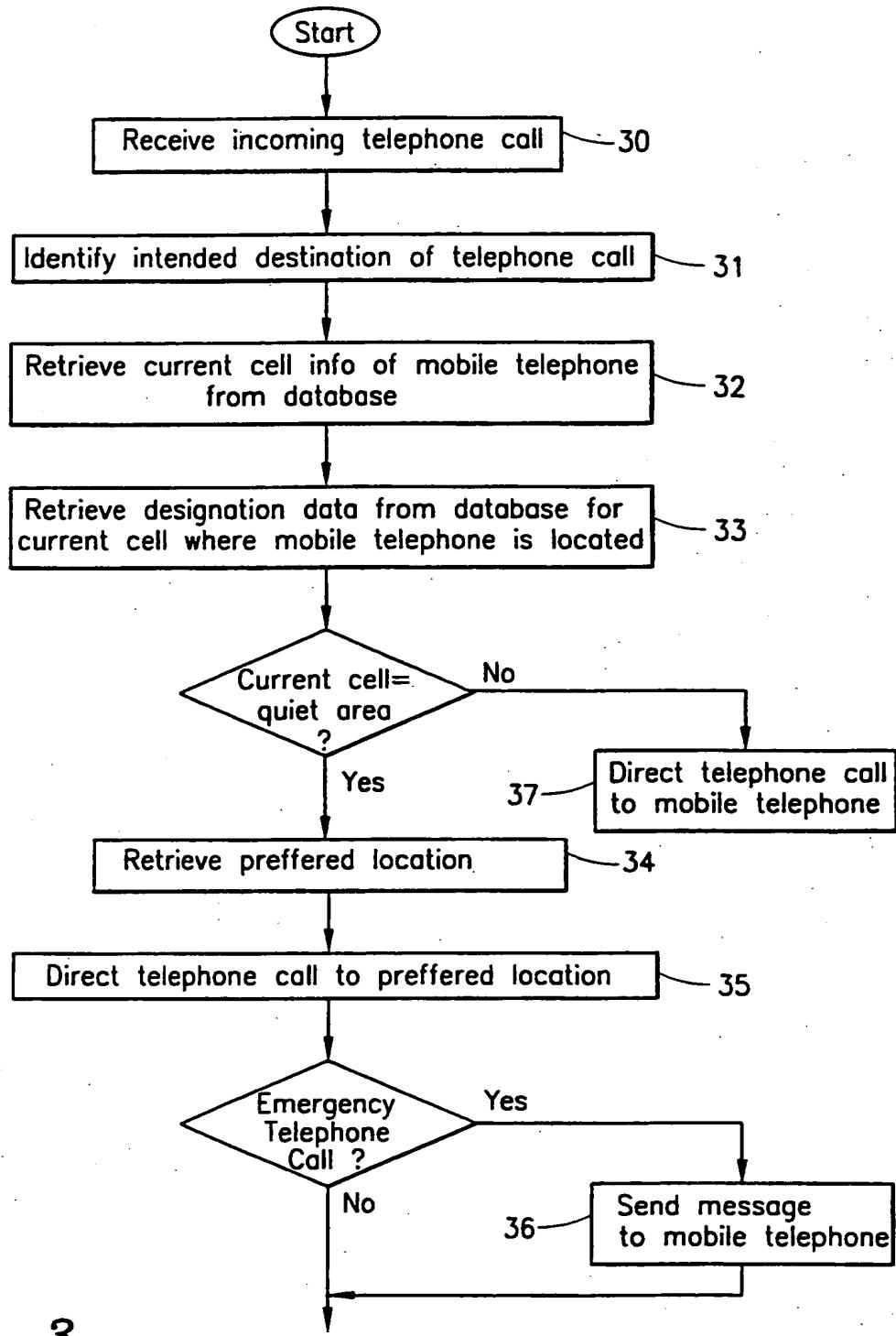


FIG. 3

INTERNATIONAL SEARCH REPORT

Int'l. Appl. No
PCT/US 00/21947

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	<p>WO 99 55102 A (NETLINE COMMUNICATIONS TECHNOLOGIES) 28 October 1999 (1999-10-28)</p> <p>abstract; figures 2,3,6 page 16, line 29 -page 17, line 17 page 21, line 4 - line 16</p>	1,3, 6-14, 18-23, 25,26, 28-31
X	<p>EP 0 881 851 A (TELEFONAKTIEBOLAGET L M ERICSSON) 2 December 1998 (1998-12-02) figure 1 column 6, line 55 -column 7, line 34 column 8, line 16 - line 27</p> <p style="text-align: center;">-/-</p>	1,12,26

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

8 November 2000

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20/11/2000

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INTERNATIONAL SEARCH REPORT

Inte lational Application No

PCT/US 00/21947

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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